

### **REMARKS**

The Office Action of September 2, 2011, has been carefully considered.

New claims 14 and 15, which further distinguish over the prior art in requiring a crystallization step, find support in paragraphs [0030] and [0050] and in Fig. 5, of the application publication US 2007/01114136. It is submitted that the prior art does not teach or suggest a method of obtaining electrolytic manganese using two purification steps and a crystallization step, followed by electrolytic processing.

Claims 7-13 have been rejected under 35 USC 112, second paragraph, as being indefinite. To overcome this rejection, claims 7 and 13 have been amended to recite that electrolyzed solutions are obtained having a manganese purity of 99.9%.

Favorable reconsideration and withdrawal of the rejection is thus urged.

Claims 7-12 have been rejected under 35 USC 103(a) as obvious over Carosella (US 2,766,197) in view of Globus (US 3,106,451) and Schowalter (US 3,905,805) with evidence from Francis et al. (US 2,277,663) and Lindkvist et al. (US 5,286,274).

It is submitted by the Applicants that the cited combination of references do not teach or suggest the claimed invention, for the following reasons:

1) In paragraph 4 of the Office Action, the Patent Office asserts that Carosella teaches *"a method of obtaining electrolytic manganese from ferroalloy manufacturing waste having manganese (see col. 1 lines 49-68 teaching the manganese slag as a manufactured by-product having manganese")*.

However, it should be noted that manganese slag has a chemical bond constitution which has nothing to do with that of the particles flown and captured such as sludge in washers. As Carosella mentions, this means that one material and not the other can be etched with sulphuric acid by lixiviation and, or some are etched in significant levels and others in negligible levels. In fact, in the present invention there is no initial treatment of the oxides, such as a reduction of  $\text{MnO}_2$ , but, rather, a thermal sulfation attack.

2) As a person of ordinary skill in the art would recognize, the anolyte has an almost zero capacity for dissolving manganese from slags by lixiviation, from both ferromanganese and silicomanganese slags.

3) In the presently claimed method, a step to remove Fe and Al is not carried out, because such removal occurs in the lixiviation of the sulfated product itself, with the return electrolyte. Furthermore, the claimed process generates a

pulp, by addition of the pH controller, which is not ammonium, industrially filterable, industrially washable and self-compactable, which does not happen in the Carosella or Globus method. In fact, it is unlikely that the Carosella and Globus methods can be carried out on an industrial scale, the low recoveries and the very long time make the respective processes unprofitable and meaningless.

4) Carosella needs waste materials where Mn is  $Mn^{2+}$  valence (slag). The Patent Office has thus ignored the basic premise of the Applicants' process: sludge waste from the washing of gases from (produced in) ferroalloy furnaces, in which there is  $Mn^{2+}$ ,  $Mn^{3+}$  and also  $Mn^{4+}$  ( $Mn^{4+}$ , pyrolusite flying dust). Thus, the Patent Office ignores the fact that no additional reducing agent is used, besides the carbon flying dust and distilled hydrocarbons from the furnace, and as well as the fact that the sulfation described in in the present application, in the presence of C and hydrocarbon, produces from any manganese: ( $Mn^{2+}$ ,  $Mn^{3+}$ ,  $Mn^{4+}$ ), and manganese sulfate ( $Mn^{2+}$ ). The thermodynamics and kinetics are very favorable.

5) The Patent Office has combined Carosella and Globus to argue that such a combination would teach a sulfation step. However, it is noted that Globus sulfates with the addition of sulfur, that this reducing agent is needed, and that the

present claims do not require the addition of sulfur.

Furthermore, Globus teaches electrolyzing the lixiviated material with water, without mentioning any purification or lixiviation conditions.

6) It is submitted that the combination of Carosella and globus is improper, because Carosella speaks about etching slag with sulfuric acid, a very difficult, and almost impossible objective due to the vitreous nature, type of MnO bond in the slag, and because Globus treats MnO<sub>2</sub>-poor mineral using a reducing agent: sulfur. None of this coincides with the present method. Neither Carosella nor Globus mention the difficulty of the solid-liquid separation which can make the process unfeasible, neither mentions the use of pH controllers different from ammonium, and neither add to the material product which aids to make the waste, which in the present method is separated in a matter of minutes, self-compactable. Accordingly, a person skilled in the art will not arrive at the presently claimed method by a combination of Carosella and Globus.

9) Based on the assertions on page 6 of the Office Action, the Patent Office argues that Schowalter discloses Mn in the particles collected in the particle collector. Indeed, the best Mn research center worldwide has tried for a long

time to profitably extract manganese from the flying dust from Fe-Mn and Si-Mn furnaces and until now, they have failed.

10) The slag composition of paragraph 2 only mentions elements and not the chemical bonds and structural constitution of the materials involved, which is what determines the conditions for the possible manganese attack (and subsequent dissolution) in the process.

11) Of the waste materials mentioned by Carosella, none are the flying dust from ferroalloy furnaces (paragraph 3, page 6).

12) The Lindkvist reference mentions: "spent potlining (SPL)", but only mentions the possibility of using ferroalloy slag as a contribution to the fusion of the SPL cathodic wastes, and the subsequent production of a metal phase and another slag phase, which have nothing to do with the claimed method. Slag is produced in the fusion with 0.4% MnO, and it is not understood how this can supplement the Carosella reference.

13) Regarding page 7, paragraph 1, of the Office Action, Applicants submit that there is no similarity between the slags of Carosella and the sludges and flying particles from ferroalloy furnaces. If the elemental composition was similar, the characteristics of the slags, as any person

skilled in metallurgy knows, are absolutely different (mineralogy-structural-bond) from that of the particles in the sludges. Regarding the second paragraph on page 7, the Carosella method, which would fail in the treatment of slags by that method (very low Mn extraction when Fe-alloy slags are acid lixiviated, as any skilled metallurgist knows), would have worse results using the materials used in the presently claimed method, namely, sludges from ferroalloys furnace gas washings.

14) Based on the foregoing, the combination of Carosella, Globus and Schowalter would not result in the presently claimed method.

15) The statement made on page 7, paragraph 4 of the Office Action is unclear and incorrect, because Globus sulfates in the presence of sulphur, as mentioned above, and the present method does not.

16) Regarding page 8, paragraph 3, of the Office Action: It is more than unlikely, as any person skilled in metallurgy knows, that an acceptable extraction can be obtained (in Applicants' method 90% in half an hour of etching) starting from a vitreous slag, which can cut the operator's hands when it is grabbed, coming from ferromanganese to silico-manganese production, since the structure and chemical bond thereof

makes it non-etchable with sulfuric acid, although it is stirred for many hours in a reactor with hot sulfuric acid and even thermally sulfating it.

17) The use of anti-acid protectors is, of course, obvious in lixiviation reactors, but they are not absolutely necessary. Anyway that description of protected equipment is not to be patented (Office Action, paragraph 4, page 8).

18) Regarding page 9, paragraph 2, of the Office Action, it is submitted that Carosella would have failed in the attempt to filter the produced product (Carosella does not use Applicants' practice and conditioning products), in which the product is etched and filtered as if the particles of the sludge from the furnaces were used, and the waste thereof would not be "inert", in Applicants' case virtually non-toxic, being able to be used on roads or outdoor fillers.

19) Regarding page 10, paragraph 3, of the Office Action: Carosella discloses an "initial treatment", without specifying what it consists of.

20) Regarding page 10, last paragraph, of the Office Action, the use of slags as materials treatable with metallurgical success is very unlikely in Carosella's patent, as a person of ordinary skill in the art would know. The precipitation of Fe, which must be  $\text{Fe}^{3+}$ , and of  $\text{Al}^{3+}$ , due to pH

adjustment, is in several metallurgy processes: zinc metallurgy, copper metallurgy, nickel metallurgy, etc. Therefore, the patent does not add anything to what is already known. But how to do it in the process, how to adjust the pH and with what, and at what time, and how to contribute to the improvement of the waste, can be original. That is original in the present method, since it produces a low toxicity waste that can be dumped to the environment and which is self-compactable. Carosella does not mention this.

21) The removal of the base metals using the  $S^{=}$  anion is was well known in the art at the time of the Carosella patent, and is not an object of patentability but it is used to achieve the purpose of producing electrolytic Mn having 99.9% purity.


22) The last paragraph of page 11 of the Office action again mentions the combination of Carosella and Globus, which as Applicants have discussed does not suggest the present method. In fact, it is surprising that the present method could be used successfully for slags, as any person skilled in metallurgy who knows the nature of slags of ferromanganese and silico-manganese would say is impossible.

In view of all of the above, it is believed that the cited references in combination, do not suggest the presently

claimed method. Accordingly, the rejection under 35 U.S.C. 103(a) based on Freundlich are unsustainable and should be favorably reconsidered and withdrawn.

Applicant submits that the application is now in condition for allowance, and an early notice to that effect is earnestly solicited.

Respectfully submitted,  
DENNISON, SCHULTZ & MACDONALD

A handwritten signature in dark ink, appearing to read "Malcolm J. MacDonald", with a stylized flourish at the end.

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